DESIGN AND DEVELOPMENT OF A MICROPOUND EXTENDED RANGE THRUST STAND (MERTS)

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The micropound extended range thrust stand (MERTS) was developed to test the various thrusters developed at GSFC. The thrust stand was designed on the basis of the six objectives shown in Figure 1. These design objectives, heretofore, were not found in a single thrust stand. This thrust stand is a torsional measurement device consisting of two major sections, the rotatable horizontal beam and the vertical support tube which is connected through flexural pivots to the fixed frame.

Thrust is measured by sensing of the horizontal displacement of the beam (occurring when the thruster is run). This is accomplished by the use of a differential capacitor sensor capable of sensing 2.54 μm. The thruster system is mounted at the extremity of the horizontal beam. An electromagnetic coil is used as a forcer and calibrator. Power is brought to the stand through the flexural pivots. All electronic connections are made on the beam. No hard wiring is connected from the fixed frame to the movable assembly, resulting in essentially a frictionless system. Other important features are a counterweight system for static balancing and a telemetry system for housekeeping and thruster data. All six objectives were met in this development. An important, unique feature of this system is its ability to make measurements in the range from 4.5 μN to 22.5 mN with a 5 percent accuracy.

Figure 2 shows the thrust stand resulting from our development effort. The rotatable horizontal beam and vertical support column are connected to the outer fixed frame through the flexural pivots. At the front end of the horizontal beam, the electronic signal conditioning and thruster package are mounted. On the rear portion of the beam is the balancing mechanism and transmitter. The fixed frame contains the differential capacitor sensor, forcer-calibrator system, and the optical link command system.

To determine the measurement accuracy of MERTS and to verify the calibration technique utilized, a cesium ion engine was tested. An ion engine produces a thrust which can be calculated exactly, and, therefore, its use is an excellent method for verifying the thrust stand's accuracy. Figure 3 shows the MERTS output (solid line) and the ion engine thrust (dotted one). As can be seen, the MERTS tracked the ion engine to within 5 percent. A check of the thrust stand calibration factor against that of the ion engine calibration factor showed only a 4.3 percent difference.

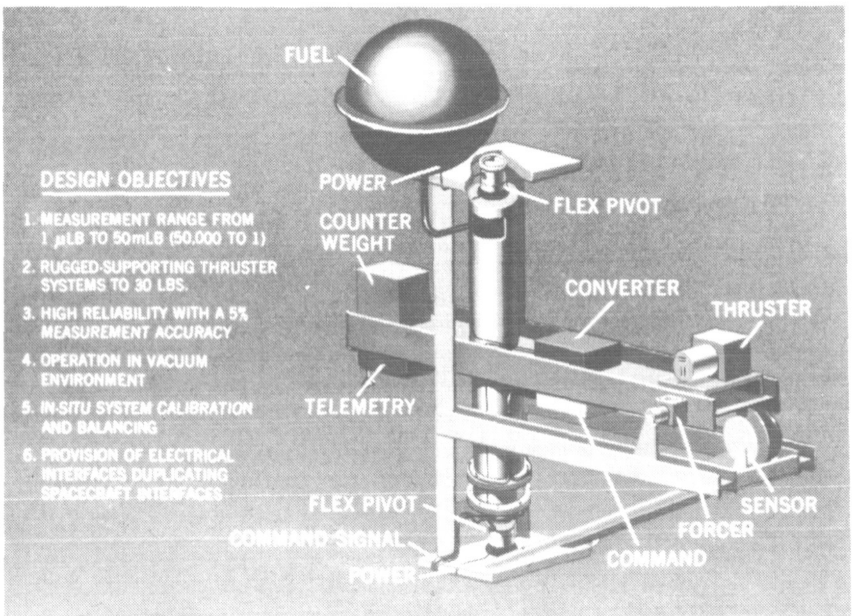

Figure 1–MERTS objectives and design.

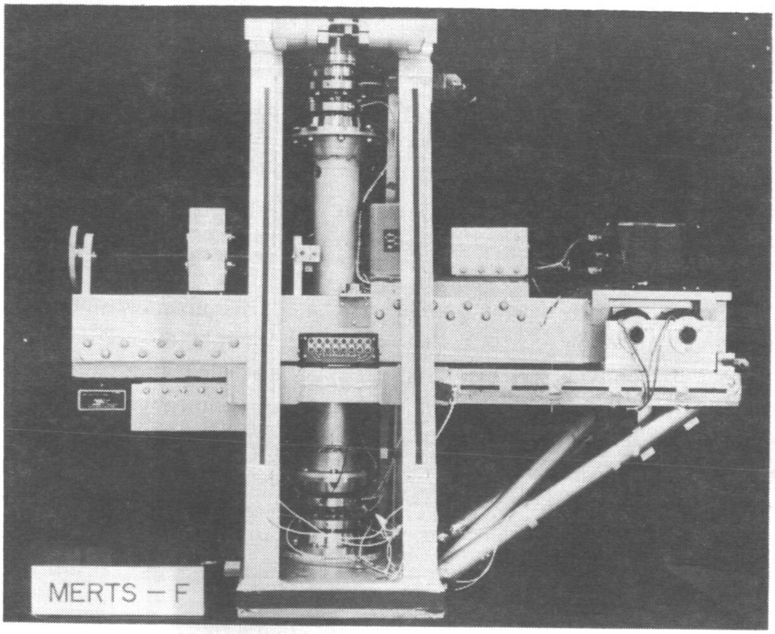

Figure 2–Working model of MERTS.

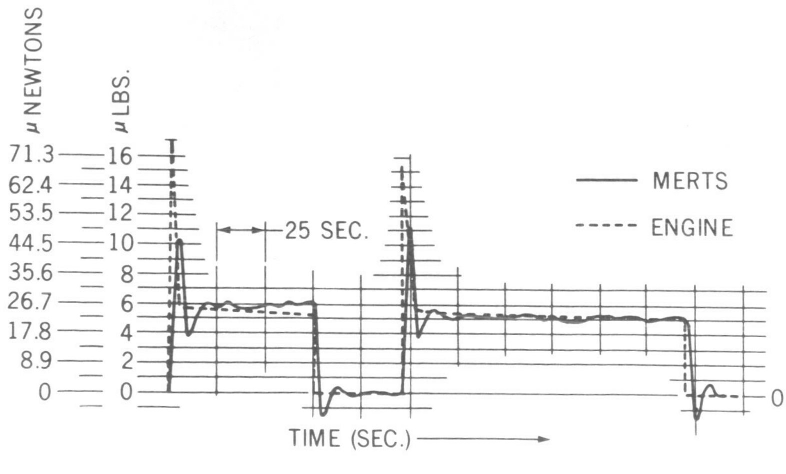

Figure 3–Comparison of thermally compensated MERTS output and ion engine output.